

# PLANT-REMAINS FROM HARAPPĀ 1946

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In this article the Wood Technologist and the Assistant Wood Technologist of the Forest Research Institute have, at the request of the Department of Archaeology, once more dealt with ancient plant-remains, this time with those found in Dr. R. E. M. Wheeler's 1946-excavation at Harappā, reported on in *Ancient India*, no. 3 (January 1947), pp. 58 ff. Owing to the highly deteriorated condition of the specimens, the task of examining and identifying them involved much more than the normal care and patience, but it is a matter of gratification that in spite of the difficulties the identifications are definite. Of great significance are the authors' inferences (p. 17) regarding the climatic conditions of the region in which some of the identified trees grew.

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## 1. INTRODUCTION

CONSIDERABLE information on the Harappā culture has been made available during the past three decades, but not much attention has till now been paid to the botanical remains recovered in the different excavations. This paper deals with some of the plant-remains collected during the 1946-excavation. Owing to the bad state of deterioration, the recovery of the plant-material has been very slow, though it has ultimately been possible to gather the remains of four timbers and to identify them as deodar (*Cedrus deodara* Loudon), rosewood (*Dalbergia latifolia* Roxb.), ber (*Zizyphus* sp.) and elm (*Ulmus* sp.). All these are well-known commercial timbers of the present day.

Two of these timbers were used for a coffin, the only discovered specimen of its type in the Indus valley cultures.<sup>1</sup> The archaeological and botanical significance of these finds is discussed below (pp. 12-17).

## 2. MATERIALS

The Director General of Archaeology in India sent us four packing cases, the contents of which were as follows:—

1. The case marked HP XXIX-128 contained five blocks of earth showing marks of planks (pl. I, 1 and fig. 1), very clearly indicating the four walls of a coffin.<sup>2</sup>

<sup>1</sup> *Ancient India*, no. 3 (January, 1947), p. 87.

<sup>2</sup> *Ibid.*, p. 87.

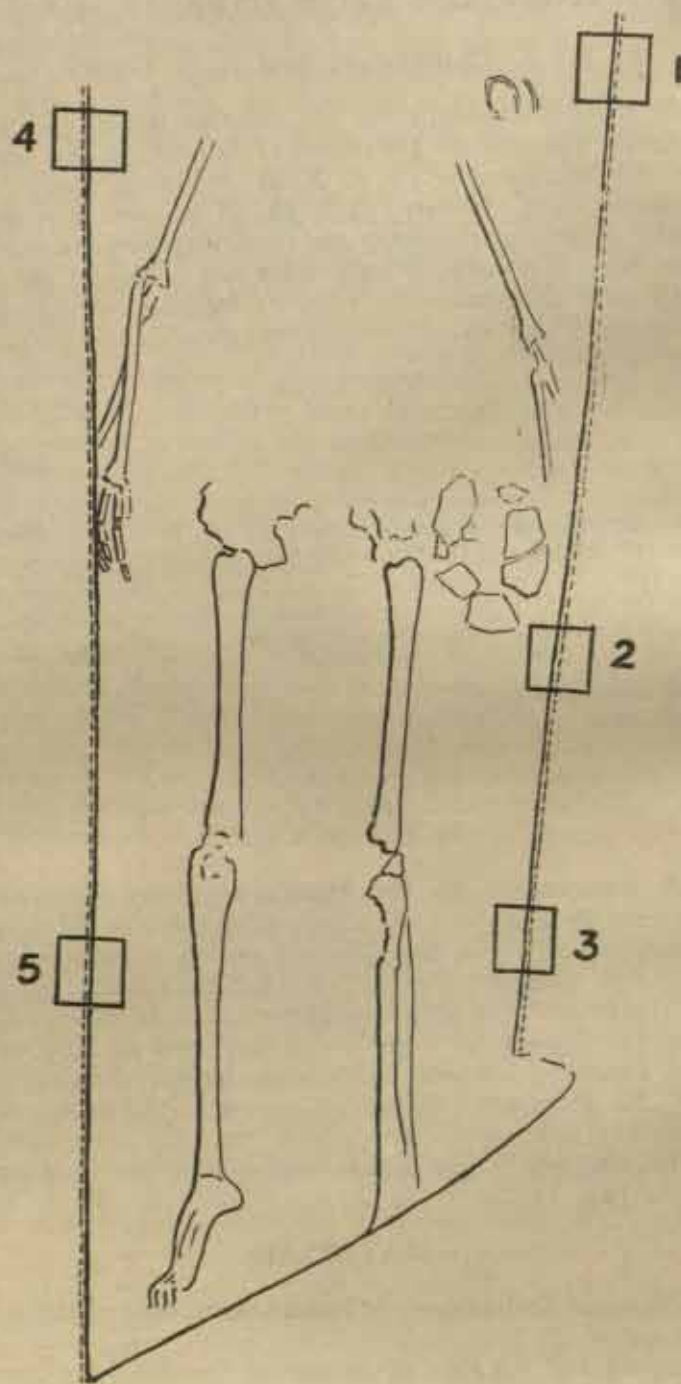


FIG. 1. Marks of coffin-wall from which five samples were taken out



2. The case marked HP XXIX-129 contained blocks of earth showing remnants of the so-called shroud from the same burial (pl. I, 4).
3. The case marked HP XLIV-1 contained surface-soil from the depression in the centre of a circular platform.<sup>1</sup>
4. The case marked HP XLIV-2 contained deposits from over the same platform.

### 3. METHODS OF STUDY

It was realized from the beginning that the identification of the plant-remains, if at all possible, would take a considerable time, but the difficulties encountered in the process were beyond expectation. Various laboratory techniques were tried, but none gave satisfactory results except the method stated below. Depending on the state of deterioration the method was used either in its entirety or in a modified form. For instance, double embedding was necessary for the materials from the coffin and the shroud but not for those from the platform, for which celloidin embedding was good enough. Altogether about two hundred mounts were prepared and examined.

The first-aid given in the field, consisting of soaking the clods of earth cut from the grave in 2.5 per cent vinyl acetate and then coating with shellac, had no doubt kept the blocks intact but did not facilitate our work. The shellac coating obscured visibility. Light treatment with toluene with a fine brush had to be resorted to in order to obtain a clear view of the plant tissues embedded in the blocks of soil. The details of the rest of the method were as follows :—

1. Pick up with a knife small bits of plant-tissues or what appeared to be plant-tissues.
2. Soak them in water for a few days and try to remove loose soil-particles.
3. Transfer to test-tubes, add water and centrifuge.
4. Transfer to watch-glass and stain with a few drops of methylene blue. This facilitated easy detection of the plant-material under a microscope.
5. Collect the tissues and wash them in acid-alcohol. Change acid-alcohol daily to remove soil particles still adhering.
6. Transfer to Eau-de-Javelle and remove quickly fine soil-particles with a brush.
7. Wash in 50 per cent alcohol and go up to alcohol-ether.
8. Transfer each bit to a petri dish containing 2 to 4 per cent celloidin and dry.
9. Turn over the material and cover it again with celloidin. When dry, cut out the bits of tissue with celloidin and transfer to embedding phials.
10. Follow the usual celloidin embedding process upto 20 per cent celloidin and harden in chloroform.
11. Embed in paraffin.
12. Cut sections on a rotary microtome.
13. Stain and mount in balsam.

At the fifth stage some tissues were found to be too small for cutting section. These were left in acid-alcohol for a day or two, then treated with potassium hypochlorite (Eau-de-Javelle) and finally mounted *in toto*.

A method used for pollen analysis by Dr. H. Godwin<sup>2</sup>, Botany School, Cambridge, England, was also tried with some modification. The results obtained were fairly satisfactory.

<sup>1</sup> *Ancient India*, no. 3, p. 78.

<sup>2</sup> Information from Dr. Godwin.

## 4. RESULTS OF STUDY AND IDENTIFICATION OF PLANT-REMAINS

A. MATERIAL FROM HP XXIX-128 (COFFIN-WALLS)  
(pl. I, 1-3 and figs. 1-4)

**ANATOMICAL DESCRIPTION.**—*Growth rings* are not traceable. This is probably owing to the small size of the available cross-sections (pl. I, 2). Only a few *vessels* have been noticed; their distribution appears to be scanty. By mounting lumps of tissues, it has however been possible to obtain longitudinal views of the vessels. They are short in length and without tyloses. Their perforation plates are simple, horizontal or nearly so. The intervessel pits are fairly large, oval, with lenticular orifice (fig. 4). *Fibres* are round to angular (pl. I, 2), irregularly arranged, non-septate. Their diameters vary from 7-24 microns, and wall-thickness is usually 4 microns. Their lumina are narrow to wide

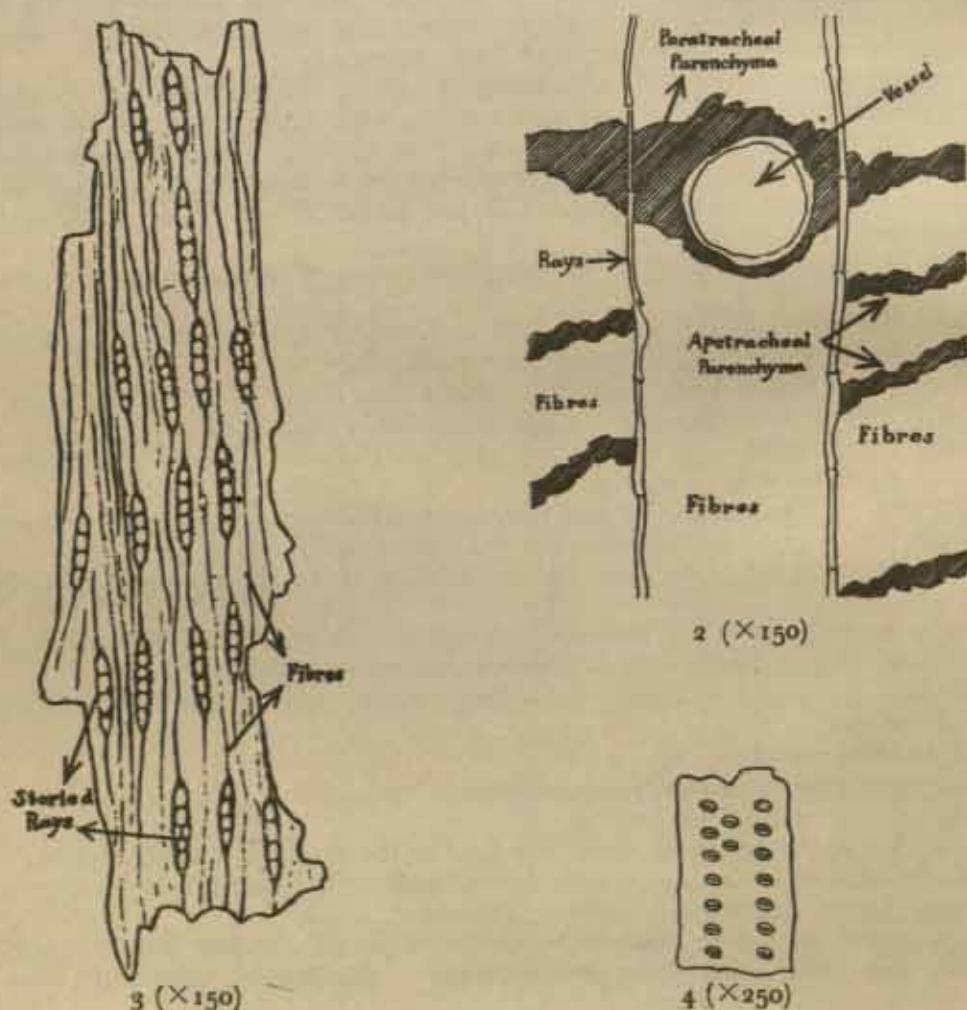


FIG. 2-4. HP XXIX-128, 2, diagrammatic sketch of cross-section; 3, sketch of tangential section showing ripple-marks; 4, drawing of intervessel pits



TABLE I

Comparative anatomical structure of the wood from Harappā as well as *Dalbergia lanceolaria*, *D. latifolia* and *D. sissoo*, and *Pterocarpus marsupium* and *P. santalinus* and their present geographical distribution in India

Timber species	Anatomical structure					Distribution
	Ripple marks	Height of rays in cells and microns	Width of rays in cells and microns	Paratracheal parenchyma	Apotracheal parenchyma	
1. Wood from Harappā (coffin-walls)	Present, about 175 per inch	4-6 cells, 75-195 microns	1-2 cells, 15-30 microns	One to several seriate sheath, aliform to aliform-confluent	1-2 seriate	
2. <i>Dalbergia lanceolaria</i> Linn.	Always present, 130 per inch	4-12 cells, up to 25-cells; usually 130-220 microns or more	1-4 cells, 13-40 microns	One to two seriate sheath inconspicuous, seldom aliform-confluent	Abundant, usually one seriate in broken tangential lines	Western Peninsula as far as Ajmer, in the north up to Siwālik, and in the east upto Bihar
3. <i>Dalbergia latifolia</i> Roxb.	Always present, 165-175 per inch	4-6 cells, 80-150 microns	1-2 cells, occasionally 3 cells, 30-45 microns	One to several seriate sheath, aliform to aliform-confluent	1-2, occasionally 3 seriate	In the north up to Oudh and Marwāra extending to the west up to Panchmahal, in the east up to north Bengal and throughout Peninsular India
4. <i>Dalbergia sissoo</i> Roxb.	Not always present, when present 150 per inch	6-15 cells, sometimes up to 25 cells, 140-215 microns	1-4 cells, 45-65 microns	One to several seriate sheath, aliform-confluent	One to several seriate in tangential lines	From the Indus to Assam throughout sub-Himalayan tract, also Baluchistan
5. <i>Pterocarpus marsupium</i> Roxb.	Always present, 110-120 per inch	6-10 cells, 140-200 microns	1-3 cells, 25-40 microns	One to several seriate sheath, mostly aliform-confluent	Scanty, 1-2 cells seriate	Northern limit Haldwāni and Mt. Abu and eastern limit Bengal. Throughout central and south India
6. <i>Pterocarpus santalinus</i> Linn.	Always present, 125-135 per inch	10-12 cells, 140-215 microns	1-2 cells, 20-28 microns	1-2 seriate sheath, usually aliform-confluent	Scanty, 1-2 cells seriate	Confined to Cuddapah district and its surrounding areas in Madras

(pl. I, 2). *Parenchyma* cells are both paratracheal and apotracheal. The paratracheals show a tendency to form aliform to aliform-confluent structure. They are usually in several rows (pl. I, 2 and fig. 2). The apotracheals are in rows of 1-2 cells, mostly single. They run short distances often forming somewhat alternate bands with those of the fibres (pl. I, 2 and fig. 2). Both types are 17-31 microns in diameter and occasionally contain darkish deposits. Rays are 1-2 seriate (pl. I, 3 and fig. 3). They are arranged in 'echelon' and form distinct ripple-marks which are about 175 per inch. Their width is 15-30 microns and height 4-6 cells and 75 to 195 microns. The individual ray cells are round to oval (fig. 3) and moderately thick-walled.

IDENTIFICATION.—The ripple-marks are formed by a regular arrangement of the rays, vessels and parenchyma cells. This structure and the distribution of paratracheal and apotracheal parenchyma suggest the affinity of the timber to the *Leguminosae* and particularly to the genera *Dalbergia* and *Pterocarpus*. These two genera have some overlapping anatomical characters which make it somewhat difficult to separate them.<sup>1</sup> This difficulty can, however, be overcome provided, firstly, 'the limit of overlapping is clearly understood' and, secondly, their general features such as colour, grain, texture and lustre are known. The anatomical details of the genera are given in Table I (p. 7), but unfortunately the data on general features are missing in the timber from Harappā. A consideration of the present distribution of the genera was therefore thought advisable before the timber from Harappā was finally identified.

Amongst the *Dalbergias* now growing in India only three species are found in the north, namely *Dalbergia lanceolaria* Linn., *Dalbergia latifolia* Roxb. and *Dalbergia sissoo* Roxb.<sup>2</sup> In the genus *Pterocarpus* there are also two likely species, viz. *P. marsupium* Roxb. and *P. santalinus* Linn. The anatomical details of these five species and their present distribution are given in Table I. It will be seen that the timber under investigation shows greater affinities with the *Dalbergia* than with the *Pterocarpus*. The number of ripple-marks per inch and the distribution of paratracheal and apotracheal parenchyma cells of the timber from Harappā agree with those of the *Dalbergia*. Finally, amongst the *Dalbergias*, the timber shows the greatest similarity to *Dalbergia latifolia* and has, therefore, been identified as *Dalbergia latifolia*.

#### B. MATERIAL FROM HP XXIX-129 (SHROUD ?) (pl. I, 4, 5, pls. II-III and figs. 5, 6)

ANATOMICAL DESCRIPTION.—*Growth rings* cannot be seen in any of the sections that have been cut. The cross-sections available only show the wood in between two growth marks (pl. I, 5 and pl. II, 1, 2). The arrangement of cells indicates that the transition from early to latewood is gradual. The timber is non-porous. *Tracheids* are squarish to rectangular, arranged in distinctly radial rows. The maximum tangential and radial diameters are 38 microns and 45 microns respectively (pl. II, 1, 2). The pits on the tangential walls are not clear. On the radial walls they are very prominently bordered. The margins of the tori are scalloped (pl. III, 3, 5). The crassulae are often clearly visible (pl. III, 5). *Vertical parenchyma* cells are scanty, mostly single. They are often clearly seen in longitudinal sections (pl. II, 4). *Resin canals* of vertical type have not been

<sup>1</sup> K. A. Chowdhury, 'Some aspects of pure and applied wood anatomy', Presidential address, Botany Section, 35th Indian Science Congress (Patna, 1948), p. 77.

<sup>2</sup> D. Prain, 'The species of *Dalbergia* of South Eastern Asia', *Annals of the Royal Botanic Garden*, X, pt. 1 (Calcutta, 1904); D. Brandis, *Indian Trees* (London, 1921).



observed, but the horizontal type is undoubtedly present in the rays. The orifice of canal is often large and oval, showing traumatic origin (pl. II, 4 and fig. 5). Rays are of two types; uniseriate and fusiform (pl. II, 3, 4). The uniseriate rays are 1-28 cells and up to 600 microns in height (pl. II, 3). Their width is 15-30 microns. The fusiform rays are very wide in the centre. Ray tracheids are non-dentate and confined to marginal position (pl. III, 1 and fig. 6). They have small bordered pits which are not very clear. The cross-field pits are usually piceoid, occasionally cupressoid (pl. III, 2 and fig. 6).

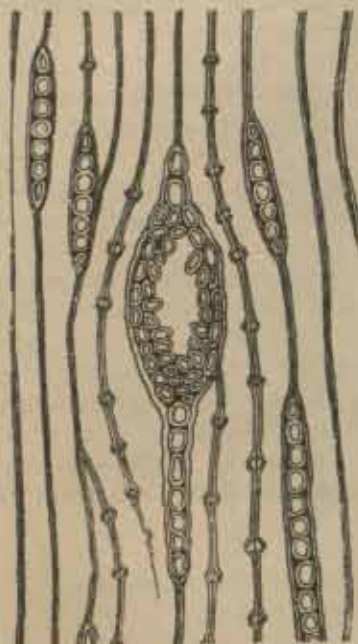


FIG. 5. *Cedrus deodara*, tangential section showing fusiform and uniseriate rays ( $\times 110$ )

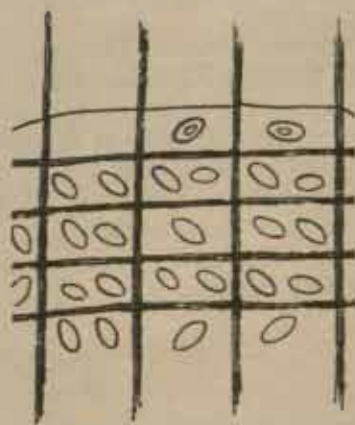


FIG. 6. HP XXIX-129. Radial section showing pits on a marginal tracheid and cross-field pitting (diagrammatic) ( $\times 400$ )

IDENTIFICATION.—The coniferous wood from Harappā shows scanty vertical parenchyma cells. This indicates its affinity to the *Pinaceae*.<sup>1</sup> The cross-field pittings match with those that belong to the sub-group *Abietoideae*. Furthermore, the normal vertical resin canals are absent but the horizontal type is occasionally present in the fusiform rays.<sup>2</sup> This is an indication that this wood is similar to *Cedrus*. This affinity is further confirmed by the presence of distinct scalloping of the tori of the bordered pits.<sup>3</sup> Four different species of *Cedrus* are recognized by the systematic botanists, but they have more or less similar anatomical structure and cannot be separated. The Harappā conifer is, therefore, named *Cedrus* sp., probably *C. deodara*.

<sup>1</sup> E. W. J. Phillips, 'Identification of softwoods', *Forest Products Research Bulletin*, 22 (1948), pp. 1-56.

<sup>2</sup> M. A. Chryslar, 'The medullary rays of *Cedrus*', *Botanical Gazette*, 59 (1915), pp. 387-396.

<sup>3</sup> I. W. Bailey, 'The cambium and its derivative tissues, VII, Problems in identifying the wood of Mesozoic Coniferae', *Annals of Botany*, XLVII (1933), pp. 145-157; E. S. Barghoorn and I. W. Bailey, 'The occurrence of *Cedrus* in the auriferous gravels of California', *American Journal of Botany*, 25 (1938), pp. 641-647.

C. MATERIAL FROM HP XLIV-1 (FROM DEPRESSION OF THE CIRCULAR PLATFORM)  
(pl. IV, 1, 2, 3)

ANATOMICAL DESCRIPTION.—*Growth rings* are not traceable in the cross-sections available to us. *Vessels* are of small to medium size, single or in radial pairs of 2 to 4, mostly 3 (pl. IV, 1). Their tangential diameters vary from 60 to 115 microns. Length of the vessel elements varies from 375 to 645 microns. They are either tailed or not so; when tailed usually at both ends. Vessel perforation plates are simple, oblique to nearly horizontal. Intervessel pits are large, alternate and rather crowded (pl. IV, 3). *Fibres* are semi-libriform, non-septate, with a tendency for radial alignment. They are 10-24 microns in diameter. The pits on their walls are simple, and few and far apart. *Parenchyma* cells are mostly paratracheal forming vasicentric to aliform structure (pl. IV, 1). *Rays* are somewhat coarse, closely spaced, 1 to 2 seriate (mostly 1) and almost homogeneous. Individual ray cells are oval to oblong, often showing solitary crystals. Height of the rays is usually low, 1-14 cells and up to 450 microns. The width is 15-30 microns (pl. IV, 2, 3).

IDENTIFICATION.—The cross-sectional view of the wood indicates its general affinity with the families *Sapindaceae* and *Rhamnaceae*. A study of the distribution of the vessels, fibres and parenchyma cells shows great similarity to 2 genera, namely *Schleichera* of *Sapindaceae* and *Zizyphus* of *Rhamnaceae*.<sup>1</sup> Furthermore, the structure of the rays and pits on the walls of fibres and vessels of the material from Harappā show complete agreement with the *Zizyphus*. The genus *Zizyphus* is represented in India by about fourteen species,<sup>2</sup> of which six have been recorded from the north-western region.<sup>3</sup> In view of the fact that timbers of these species are not always possible to separate, the wood from Harappā is identified as *Zizyphus* sp.

D. MATERIAL FROM HP XLIV-2 (FROM ABOVE PLATFORM)  
(pl. IV, 4, 5, 6, 7, 8 and figs. 9, 10, 11)

ANATOMICAL DESCRIPTION.—No entire growth ring is visible. Two cross-sections show growth marks and these are formed by 2 to 3 rows of parenchyma cells. From the structure visible in different microscope sections, it has been possible to build up a diagrammatic drawing of the transverse section of the wood (fig. 9). *Vessels* are small to medium, 105 to 135 microns in tangential diameter (pl. IV, 4, 7, 8) and are moderately thick-walled, single or in radial pairs. The length of the vessels is short. The perforation plate is simple. The intervessel pits are alternate, round to oval with lenticular orifice (pl. IV, 6). The secondary walls show fine spiral thickening (fig. 11). *Fibres* are semi-libriform, arranged in an irregular fashion but forming a uniform pattern throughout. They are non-septate, fine, 7-19 microns in diameter. Their walls are 3-7 microns thick. *Parenchyma* cells at first appear to be terminal or initial. However, a careful examination shows that they are more like the initial than the terminal type. Paratracheal parenchyma cells are in rows of 1-4, forming a rugged pattern round the vessels. They are 14-27 microns in diameter. *Rays* are 3-4 seriate, mostly 3, almost homogeneous (pl. IV, 5 and figs. 10, 11). They are 45-75 microns wide and 630 microns high. The individual ray cells are large and oval and frequently contain gummy deposits. Some also show single crystals.

<sup>1</sup> R. S. Pearson and H. P. Brown, *The Commercial Timbers of India*, I (Calcutta, 1932).

<sup>2</sup> D. Brandis, *op. cit.*

<sup>3</sup> R. N. Parker, *A Forest Flora for the Punjab* (Lahore, 1918).



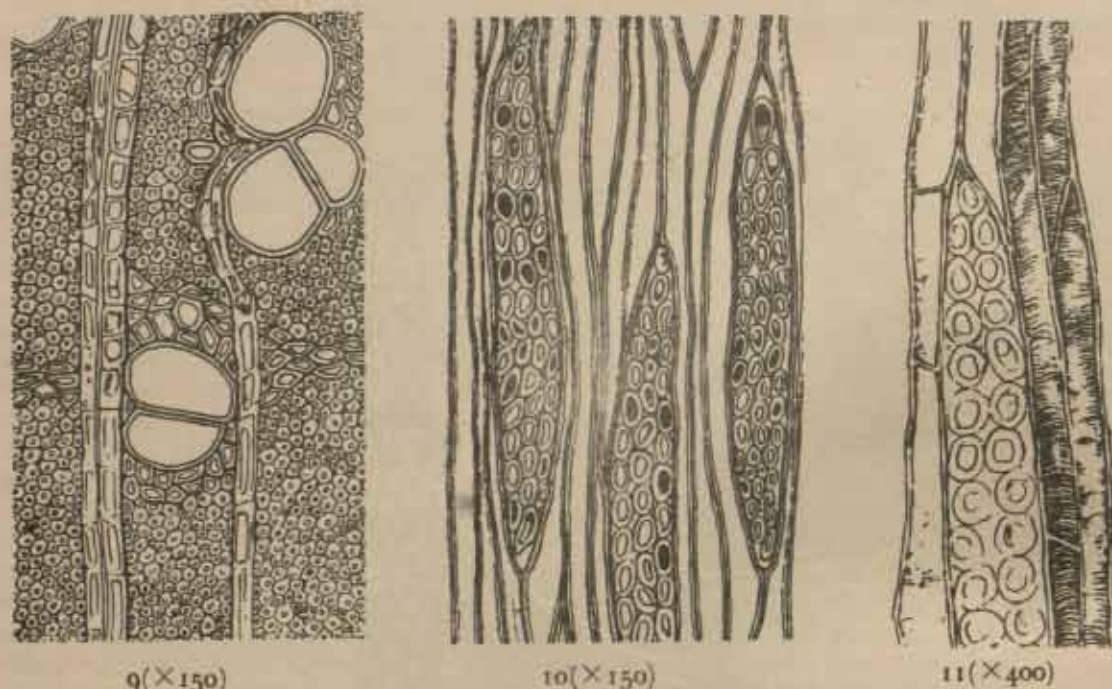


7 ( $\times 200$ )



8 ( $\times 200$ )

FIGS. 7-8. *Tangential views of rays.* 7, *Celtis*; 8, *Ulmus*



FIGS. 9-11. HP XLIV-2, diagrammatic sketches. 9, transverse section ; 10, tangential section showing rays ; 11, tangential section showing vessels with spiral thickening on the right-hand side

**IDENTIFICATION.**—The semi-ring porous structure of the wood gives a valuable clue to its identity. Furthermore, the rays are broad ; the scanty parenchyma cells are mostly confined round the vessels. These anatomical features, plus the peculiar pattern formed by the fibres, indicate the affinity of the timber with the genera *Celtis* and *Ulmus* of the *Ulmaceae*. It is well-known that the minute anatomical structure of the woods of *Celtis* and *Ulmus* is similar except for the rays.<sup>1</sup> The rays of *Ulmus* are almost homogeneous,<sup>2</sup> while those of the *Celtis* are distinctly heterogeneous,<sup>3</sup> often showing prominent sheath cells<sup>4</sup> (figs. 7, 8). The wood from Harappā with its homogeneous rays should, therefore, be grouped along with the *Ulmus*. Four species of *Ulmus*, namely *U. lancifolia*, *U. parvifolia*, *U. villosa* and *U. wallichiana* grow in India. Of these, all show ring-porous character except *U. lancifolia*, which is semi-ring-porous. An affinity of the Harappā material with *U. lancifolia* is therefore evident. But we do not feel inclined definitely to identify it as *U. lancifolia* for reasons given below (p. 15). The timber from Harappā is identified as *Ulmus* sp., belonging to the group which has diffuse-porous to semi-ring-porous wood.

## 5. DISCUSSION

### A. ARCHAEOLOGICAL SIGNIFICANCE

The first coffin recovered from the Indus valley is made of two timbers. The side-walls are rosewood (*Dalbergia latifolia* Roxb.) and top-plank covering the upper portion

<sup>1</sup> H. P. Brown and others, *Text Book of Wood Technology*, I (New York, 1949).

<sup>2</sup> S. H. Clarke in *Forest Products Research Bulletin*, no. 7 (1930).

<sup>3</sup> O. Tippe, 'Comparative anatomy of Moraceae and their presumed allies', *Botanical Gazette*, 100, no. 1 (1938).

<sup>4</sup> C. R. Metcalfe and L. Chalk, *Anatomy of the Dicotyledons*, II (Oxford, 1950).



of the body is deodar (*Cedrus deodara* Loudon). The coffin is stated to be 7 ft. long and 2 to 2½ ft. (towards the head) wide.<sup>1</sup> Its height and shape are not known for all that was left of it was the marks of its side-walls about 1½ in. thick. The excavator has reported that 'traces of a reed-shroud, available from the pelvic girdle to the upper vertebrae, were also met with'. But when microscopic examination of the traces of the supposed reed-shroud was made, it yielded only deodar wood. Proof of a reed-shroud is therefore absent. This point will be further discussed later on.

The question now arises whether coffin-burial was in practice in Vedic India. The *Rigveda-saṃhitā* merely mentions the burial of a warrior and nothing more, while the *Ātharvaveda-saṃhitā* contains reference to a burial where the trunk of a tree was used as coffin. In both the *Saṃhitās* we find mention of a 'house of earth' (*bhūmigrīha*) for burial.<sup>2</sup> It will, therefore, be seen that there is no mention of the type of burial met with at Harappā.

On the other hand coffin-burial was a common practice in the Near Eastern civilizations.<sup>3</sup> The available information on the timbers<sup>4</sup> used by them in the construction of coffin is given in Table II (below, p. 14). The timbers have been used in two forms, firstly as plywood, and secondly as solid timber. Except for the Old Egyptian Kingdom, all the coffins appear to have been made of solid planks. An important point is that the timbers so far recorded for the coffin from Iraq and Egypt are well-known for the scent they have, e.g. cypress, juniper, cedar and pine. At Harappā also one of the timbers used is cedar or deodar. The other timber is rosewood, which is also known for its sweet scent. The remarkable similarity in the choice of wood for the coffin at Harappā on one hand and Iraq and Egypt on the other may not be without any significance. This point is especially emphasized in the use of rosewood. When a substitute was used, it had to be a scented wood.

As has been stated above the results of our examination of the Harappā specimens do not allow us to conclude that there was a shroud, made of 'reed or matting'. However, a mark dividing the body from the pelvic girdle to the upper vertebrae was noticed. How this mark came about we do not know, but it might have been created by the wooden planks used for the coffin, about the construction of which we know nothing.

It is important to note in what way the coffin-burial at Harappā resembles or differs from the Mesopotamian ones. The identification of deodar wood as covering the upper part of the body does not in any way go against Wheeler's conclusion on the similarity of coffin-burial between the Harappā and the Sumerian civilizations. For, Woolley states that in the Sargonic and pre-Sargonic graves at Ur 'the dead man was laid at the bottom of the shaft either wrapped in matting or enclosed in a coffin which might be made of matting, of reeds, or wickerwork, of wood or of clay'.<sup>5</sup> Thus, the

<sup>1</sup> *Ancient India*, no. 3 (1947), p. 87.

<sup>2</sup> For the Vedic evidence, see A. A. Macdonnell and A. B. Keith, *Vedic Index* (London, 1912), I, p. 8, and II, p. 319.

<sup>3</sup> H. R. Hall in *Antiquity*, 2 (1928), pp. 56-68; R. Mond and O. H. Myers, *Cemeteries of Aramit*, I (London, 1937); H. Schäfer in *Sitzungsberichte der Preussischen Akademie der Wissenschaften*, 1931 (Berlin).

<sup>4</sup> W. Ribstein, *Zur Kenntnis der im alten Aegypten Verwendeten Holzarten* (1925); also L. Keimer, *Die Gartenpflanzen im alten Aegypten* (Berlin, 1924); R. Engleback in *Annales du service des antiquités de l'Égypte*, 31 (1931); A. Lucas in *Empire Forestry Journal*, 13, no. 2 (1934), pp. 213-218; A. Lucas in *Annales du service des Antiquités de l'Égypte*, 36 (1936).

<sup>5</sup> C. L. Woolley, *Ur Excavations II: The Royal Cemetery* (London and Philadelphia, 1934), pp. 135 ff.

microscopic examination of the remains of the Harappā coffin provides an additional proof of a possible connexion between the Indus valley and Sumer.

TABLE II

*Woods used for coffins and shrines over tombs*

<i>Place</i>	<i>Date</i>	<i>Solid timber or plywood</i>	<i>Names of timbers</i>
Egypt	About 2980 to 2475 B.C. (Old Kingdom)	Six-plywood	1. Cypress ( <i>Cupressus</i> ) 2. Juniper ( <i>Juniperus</i> ) 3. Pines ( <i>Pinus</i> ) 4. Cedar ( <i>Cedrus</i> ) (?)
Egypt	About 2160 to 1788 B.C. (Middle Kingdom)	Solid wood	1. Cedar ( <i>Cedrus</i> )
Egypt	About 1350 B.C. (tomb of Tut-ankhamen)	Solid wood	1. Cedar ( <i>Cedrus</i> ) * 2. <i>Zizyphus spina christi</i>
Ur	About 2000 B.C.	Solid wood (?)	Not reported
Harappā	About 2000 B.C.	Solid wood	1. Deodar ( <i>Cedrus</i> ) 2. Rosewood ( <i>Dalbergia latifolia</i> )

The plant-remains from the depression of the circular platform have yielded the wood of *Zizyphus*. According to Wheeler, 'the platform surrounded a wooden mortar where grain was pounded by one or more workers with long pestles'. This style of pounding grain is still prevalent in north India, and, what is more important, the trunk of *Zizyphus* tree is preferred to any other. It is remarkable that for the last four thousand years *Zizyphus* trunk has been in use for the construction of mortar for pounding grains and modern science has brought about no change.

We do not know for what purpose the wood of elm was used and got deposited over the platform. There is no doubt that the tree was not available near about Harappā.<sup>1</sup> It is a mystery how it came there from such a long distance and for what special use.

#### B. BOTANICAL SIGNIFICANCE

Archaeologists have discussed at length the various evidences that have led them to draw conclusions on the climate and the vegetation of north-west India during the Harappā culture. They are of the opinion that millions of kiln-baked bricks used for the construction of the city meant an easy availability of fire-wood of local origin. The elaborate drainage-system in the city presupposes a heavy rainfall at least for a few months in the year. The remains of animals such as the tiger, rhinoceros and elephant indicate the existence of a moist tropical forest somewhere nearby. Furthermore, the motifs

<sup>1</sup> For the distribution of elm, see below, p. 16.



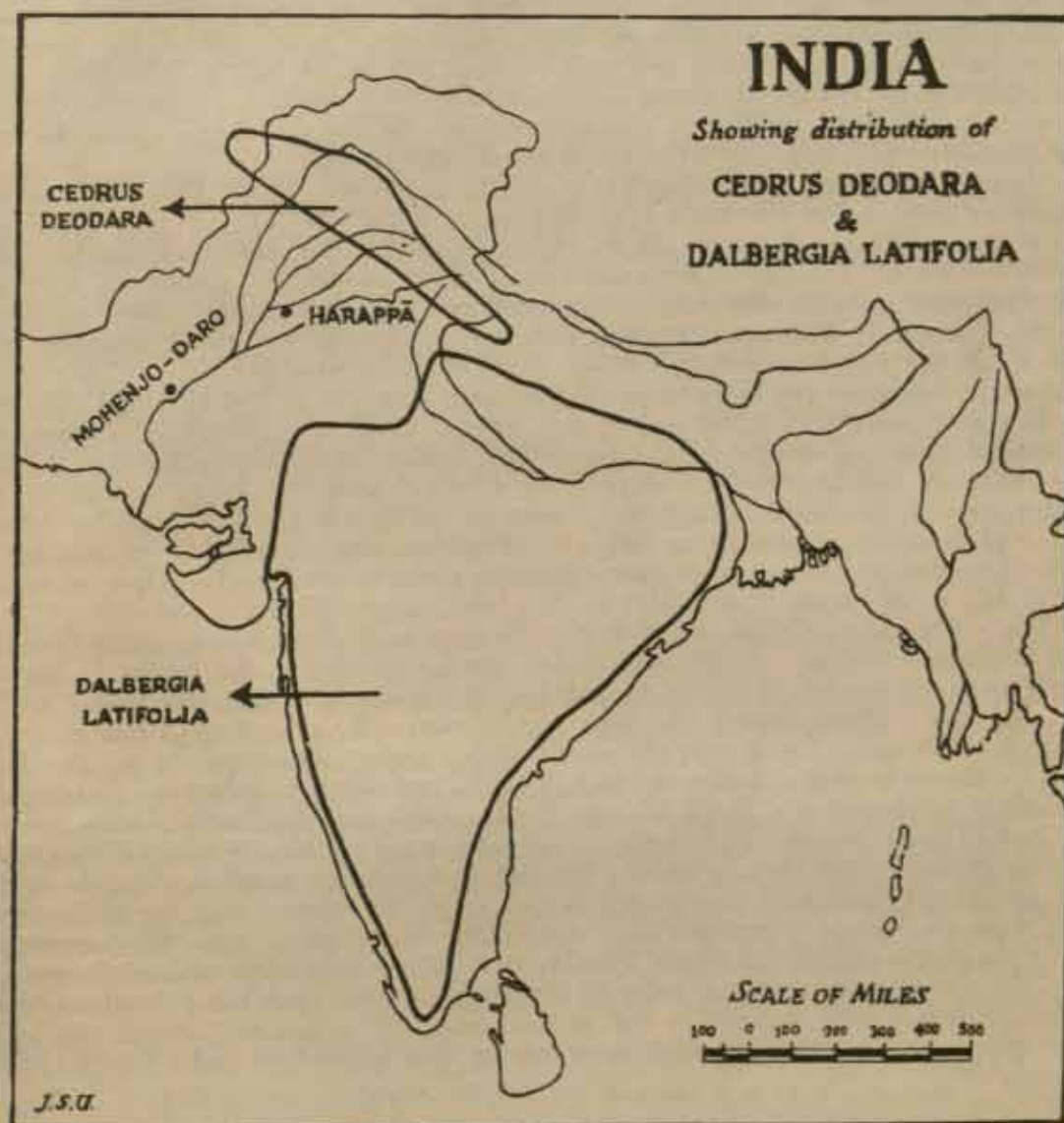


FIG. 12

of pottery-painting show an acquaintance with the trees and plants of a moist climate. These are, however, all indirect evidences. Now let us see what direct light the present study throws on the problem of climatic changes.

**ROSEWOOD.**—It now grows in the north in Oudh (Uttar Pradesh) and Mārṣāra (Rajasthan), extending to the west up to Panchmahals of Bombay State (fig. 12). The distance between Harappā and the nearest locality where rosewood grows now is not more than 350 miles. It is not unlikely that four thousand years ago rosewood was growing near about Harappā<sup>1</sup> and that with the formation of desert conditions it has migrated southwards. Another alternative that suggests itself is that we may still be ignorant of the southern boundary of the Harappā culture, for there might have been settlements further south with which the Harappans had contacts. In that case the people of Harappā could have obtained rosewood from the southern settlements.

**DEODAR.**—The present distribution of deodar is confined to the hills. It grows in Afghanistan and western Himalaya extending up to Nepal (fig. 12). It is usually found at an elevation of 6,500 ft. to 12,000 ft. above sea-level. The source of supply of this timber for Harappā seems to be from the hills of northern India—a distance of over 500 miles. Can it be possible that deodar trees grew at that time at a much lower elevation than they do now? This possibility has, however, to be ruled out as the distribution of deodar could not have been very different at that time from what it is now, in view of the fact that the effects of the last glaciation were over long before the Harappā culture.

The next point is, how this timber was brought down to Harappā. Archaeologists have located many centres of the Harappā culture,<sup>2</sup> some of which were situated at the foot of the hills. In addition to this, the presence of *silajū*<sup>3</sup> and 'the horns at least of the Kashmir, spotted, Sambhur and hog deer'<sup>4</sup> amongst the finds at Harappā provides indirect evidence of communication with the hills. All these data provide sufficient information to visualize how deodar timber came to be used in the plains of the Panjab. Here we cannot think of any other means of transport at that time except the river.

**BER.**—The genus *Zizyphus* contains over 60 species, of which, according to Brandis,<sup>5</sup> 14 are available in India. Parker mentions six species growing in the Panjab.<sup>6</sup> We are not sure to which species the timber from Harappā belongs. All that can be said is that the timber was available locally and was used as mortar for pounding grains.

**ELM.**—The genus *Ulmus* is for the most part confined to the temperate region. Four species are known to grow in India, of which three (*U. wallichiana*, *U. villosa* and *U. parvifolia*) are confined to the western Himalaya and the foot-hills, and the fourth (*U. lancifolia*) is found in the central and eastern Himalaya extending to the south up to Khasi Hills, Chittagong and Burma. The plant remains from Harappā resemble most *U. lancifolia* which has a semi-ring-porous to diffuse-porous timber. On the other hand, the three *Ulmus* species from the western Himalaya are prominently ring-porous. Now the question is: how did the people of Harappā obtain this timber? Three possibilities present themselves. Firstly, *U. lancifolia* grew in the western Himalaya at that time but has changed its distribution and is now confined to the eastern zone. Though such a suggestion might at first appear to be a mere speculation, it can be true in view of what Randhawa has

<sup>1</sup> M. S. Vats, *Excavations at Harappā* (Calcutta, 1940), p. 468.

<sup>2</sup> Stuart Piggott, *Prehistoric India* (London, 1950), p. 136.

<sup>3</sup> *Ibid.*, p. 175.

<sup>4</sup> *Ibid.*, p. 135.

<sup>5</sup> D. Brandis, *Indian Trees* (London, 1921).

<sup>6</sup> R. N. Parker, *A Forest Flora for the Panjab* (Lahore, 1918).



pointed out about the distribution of *Saraca indica* between 2,500-2,000 years ago and now.<sup>1</sup> Secondly, there has been no change in its distribution within the last four thousand years, which would mean a very long lead of transport, for which there is little evidence. Thirdly, a species allied to *U. lancifolia*, having semi-ring-porous to diffuse-porous structure, grew on the western Himalaya but has since been wiped out. There is some support for this view from palaeobotanical record, as an unrecognized species of *Ulmus* has been reported from the Lower Pleistocene Karewa deposits of Kashmir.<sup>2</sup> This report is based on leaf-impression and does not say whether the timber was ring-porous or semi-ring-porous. Further information on all the three points will be necessary before we can say which view is correct.

The light that the plant-remains of Harappā throw on the climate and the vegetation of the place may now be summarized here. Out of the four wood remains, two, viz. deodar and elm, were from the hills and could not have grown near about Harappā and must have been obtained from some distance. The other two, i.e., rosewood and ber, were either local trees or brought from a neighbouring forest. These wood remains do not support the theory that a moist tropical forest prevailed in the neighbourhood of Harappā. Keeping in view the fact that Harappā was a capital of a highly civilized state, a luxuriant forest in the neighbourhood would mean many more uses of the forest-produce than has so far been recorded. Furthermore, previous reports show that even for house-building timbers like pine<sup>3</sup> and deodar<sup>4</sup> were obtained from considerable distances. From these and other evidences we visualize a vegetation of scrub forest with tall grass and pockets of marshy land at or near Harappā. The rainfall must have been heavy for a few months in the year.

## 6. SUMMARY

1. Some plant-remains from the excavation at Harappā in 1946 have been studied and are reported here. They have yielded four commercial timbers.

2. For the coffin, two timbers were used, viz. *Dalbergia latifolia* (rosewood) for the side-walls and *Cedrus* sp., probably *C. deodara* (deodar, cedar), for the top-planks. The wood remains from the depression of a circular platform are *Zizyphus* sp. (ber). Remains from the top of the same platform are wood of *Ulmus* sp. (elm).

3. The archaeological significance of these finds is discussed in some details, especially with reference to the ancient Indian, Mesopotamian and Egyptian civilizations. The remarkable similarity in the use of timbers for the coffin at Harappā and those of ancient Mesopotamia and Egypt is interesting. The use of scented timbers in both the cases may be of some significance. The earlier report on the presence of a reed-shroud over the coffin has not been confirmed, and it appears that there was a deodar cover over the upper part of the body. Some additional proof for the contacts between the Indus valley and Sumer is thus established.

4. Of the four timber remains, two are of local origin and the other two are from hills. Use of hill-timbers indicates, firstly, trade-connection of the people of Harappā

<sup>1</sup> M. S. Randhawa, 'Progressive desiccation of northern India in historical times', *Journal of the Bombay Natural History Society*, 45 (1945), pp. 558-65.

<sup>2</sup> G. S. Puri, 'Some fossil leaves of the *Ulmaceae* from the Karewa deposits of Kashmir', *Journ. Indian Bot. Soc.*, XXIV, no. 4 (1945), pp. 186-87.

<sup>3</sup> M. S. Vats, *Excavations at Harappā* (Calcutta, 1940), p. 162.

<sup>4</sup> Piggott, *op. cit.*, p. 135.

with those of the hills and, secondly, insufficiency of suitable local timbers. All botanical evidences lead one to think that, four thousand years ago, near about Harappā there was a scrubby forest with pockets of marshy land and tall grasses, where rainfall was limited to a few months in the year.

## 7. ACKNOWLEDGEMENT

We are grateful to the Director General of Archaeology in India for giving us an opportunity of studying these plant remains. Acknowledgements are also due to the authorities of the British Museum, London, for library facilities, and to Dr. F. N. Howes, Keeper of Museum, Royal Botanic Gardens, Kew, England, for allowing one of us (K.A.C.) to examine Boodle's collection of ancient plant materials from Egypt.

## EXPLANATION OF PLATES

### PL. I

*Dalbergia latifolia* Roxb (no. HP XXIX-128)

1. A photograph of the mark in coffin-wall. Natural size.
2. Transverse section showing the general structure of the wood. Note the distribution of vessels and parenchyma cells, and the shape of the fibres ( $\times 250$ ).
3. A tangential view of the wood. Note size and shape of the rays and the ripple-marks ( $\times 110$ ).

*Cedrus deodara* Loudon (no. HP XXIX-129)

4. A photograph of the mark of shroud (?). Natural size.
5. Transverse section showing the general structure of the wood ( $\times 90$ ).

### PL. II

*Cedrus deodara* Loudon (no. HP XXIX-129)

- 1 and 2. Transverse sections of the wood showing tracheids and rays. ( $\times 110$ ).
3. Tangential section showing uniseriate rays. Note their height and the shape of individual cells. ( $\times 110$ ).
4. Tangential section showing a fusiform ray with horizontal gum duct. Also note the vertical parenchyma cells. ( $\times 110$ ).

### PL. III

*Cedrus deodara* Loudon (no. HP XXIX-129)

1. Radial section showing marginal cells of the rays. Note the pitting. ( $\times 110$ ).
2. Radial section showing cross-field pitting. ( $\times 400$ ).
3. Radial section showing pits on the radial walls of tracheids. Note scalloped margin of the tori. ( $\times 450$ ).
4. Radial section showing penetration of fungal hyphae. ( $\times 110$ ).
5. Radial wall of a tracheid showing crassulae. ( $\times 200$ ).

### PL. IV

*Zizyphus* sp. (no. HP XLIV-1)

1. Transverse section showing the general structure of the wood. Note the arrangement of the vessels, paratracheal parenchyma and semi-libriform fibres. ( $\times 110$ ).
2. Tangential section showing distribution of uniseriate rays and non-septate fibres. Note crystals in the ray cells. ( $\times 110$ ).
3. Tangential section. Note large, alternate intervessel pits on the right hand side. ( $\times 200$ ).

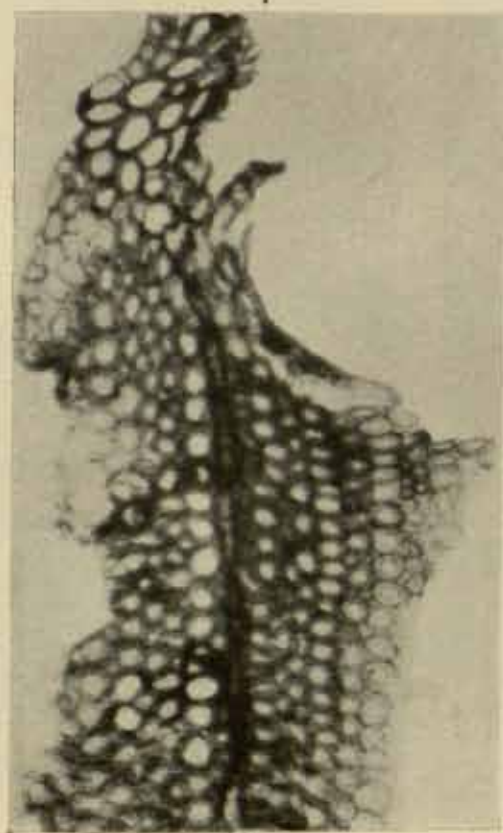




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1-3, *Dalbergia latifolia*; 4-5, *Cedrus deodara* (see page 18)



1



2



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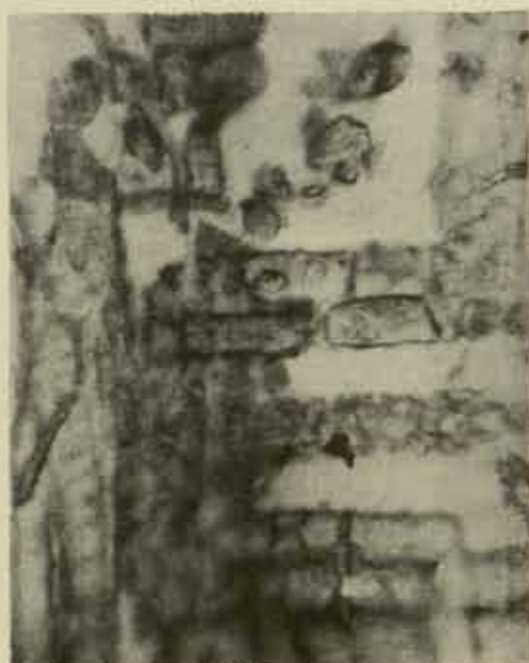


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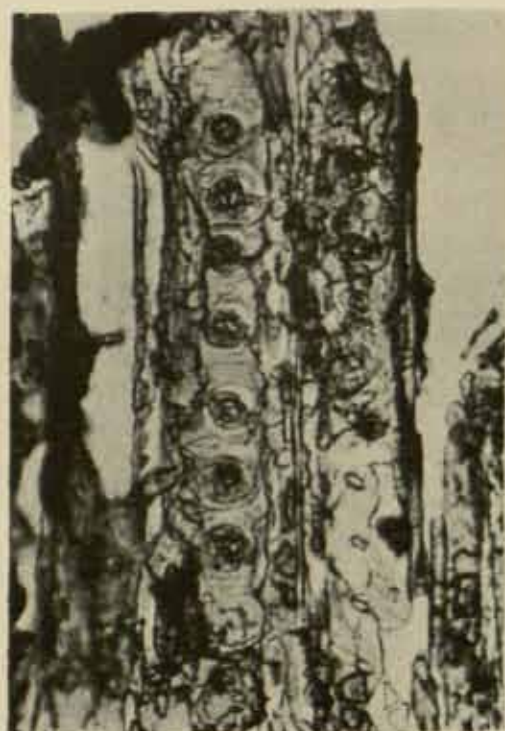




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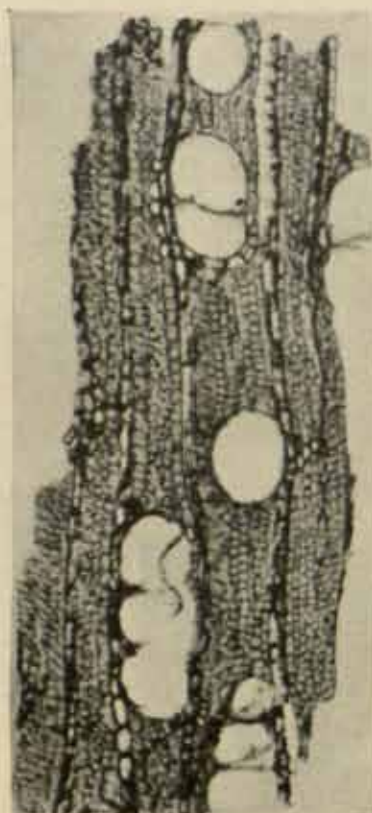


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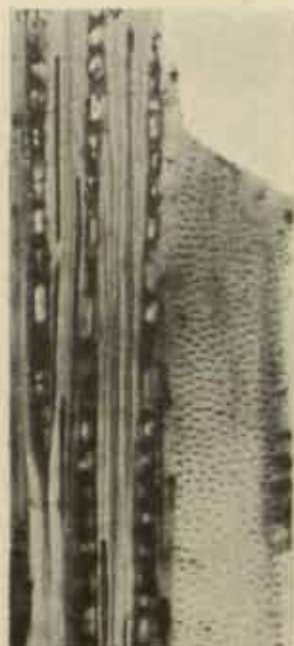
*Cedrus deodara* (see page 18)



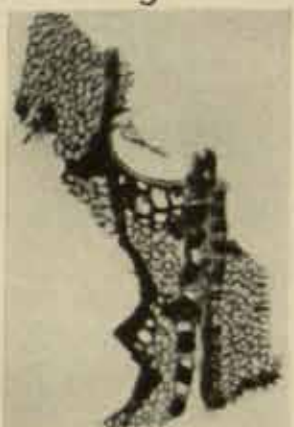
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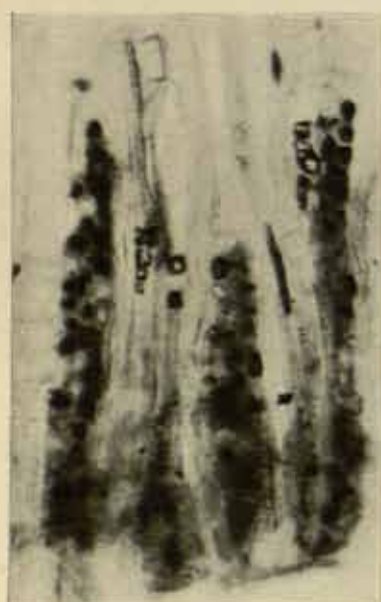
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7



8



*Ulmus* sp. (no. HP XLIV-2)

4. Transverse section showing vessels in part, paratracheal parenchyma, rays and fibres. Note crystals in rays. ( $\times 110$ ).
5. Tangential section showing shape and size of the rays. Note large and oval ray cells often containing deposits. ( $\times 110$ ).
6. Tangential section showing part of vessel with inter-vessel pits. ( $\times 110$ ).
7. Portion of transverse section. Note size and shape of a vessel. ( $\times 110$ ).
8. Another portion of transverse section. Note band of initial parenchyma cells in the middle on the right hand top portion ; shape and size of the fibres are distinctly visible. ( $\times 110$ ).